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WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

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MEMORANDUM

SUBJECT: **Aldicarb**– Ecological Risk Conclusions for the Proposed Section 3 New Use Registration for Oranges and Grapefruit Crops in Florida

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The Environmental Fate and Effects Division (EFED) recently completed its review of the new use request for the carbamate insecticide aldicarb [AgLogic 15GG, EPA Reg. No. 87895-4 (15% a.i.; PC Code 098301)] on orange and grapefruit crops in Florida to control the Asian Citrus Psyllid and other pests. Aldicarb is currently registered on cotton, dry beans, peanuts, soybeans, sugar beets and sweet potatoes as a granular formulation with maximum single and annual application rates of 4.95 lbs a.i./A (in sugar beets; other crops have lower rates), which is the same rate as the proposed maximum use rate in orange and grapefruit trees. As use rates are similar to previously registered application rates, EFED anticipates that ecological risks are similar to those determined in previous risk assessments (*e.g.* Reregistration Eligibility Decision, USEPA 2006 and Registration Review Risk Assessment, USEPA 2015). Additionally, citrus was a previously registered use for aldicarb, so it is anticipated that the risks would be similar from this proposed use. The exception to this may be for potential risk to honey bees, as while there are other registered used of aldicarb that are considered pollinator attractive, due to the lack of

honey bee data, potential risk to honey bees beyond acute contact exposures were not assessed. Therefore, this memo includes a conservative Tier I risk assessment for honey bees that was conducted for the proposed action.

Summary of Risk Conclusions

Based on previous risk assessments, EFED concludes that the proposed new use may cause acute and chronic risks for birds (and reptiles and terrestrial-phase amphibians, for which birds are considered surrogates) and mammals consuming granules. Ingestion of a single granule is sufficient to result in mortality to birds and mammals. Given the high application rate, the level of risk (*i.e.* RQs) is anticipated to be more similar to risks previously identified for sugar beets than for use sites with lower application rates. Incident data are also available documenting the death of birds and mammals associated with aldicarb use, but these were generally considered misuses.

Based on previous risk assessments, EFED concludes that the proposed new use may cause acute and chronic risks to fish and aquatic invertebrates exposed to aldicarb residues in runoff from dissolved granules. For potential risks to aquatic organisms, although incorporation of the granules will reduce runoff of aldicarb into nearby aquatic systems, it will not eliminate runoff exposure. Based on the previous risk conclusions in the Registration Review draft risk assessment, even with only 0.1% of the compound available (99.9% incorporated, based on banded/sidedress and in-furrow application), all fish and aquatic invertebrate acute and all chronic RQs calculated exceed LOCs for current uses. Incident data are available documenting fish kills associated with the registered use of aldicarb.

Previous risk assessments have not assessed dietary risk posed by aldicarb uses to bees due to a lack of toxicity data. For this proposed new use, EFED conducted a conservative Tier I risk assessment to characterize potential risks to bees and other beneficial insects. To fill data gaps, available data from similarly structured carbamate insecticides were used as surrogates for aldicarb. This conservative assessment indicates that the proposed new use may cause mortality to individual bees from acute and chronic dietary exposures. Although contact exposure and risk is not expected for honey bees, soil dwelling bees and other beneficial invertebrates living in the soil could experience contact exposures to aldicarb. Therefore, there may be risk of mortality to soil dwelling bees from contact exposure. It is noted that the current proposed label restricts application of aldicarb to 100,000 treated acres which will limit the spatial exposure extent and associated risk.

Data Gaps

EPA has previously noted uncertainty in the acute and chronic oral risk of aldicarb to honey bees as not all the Tier I honey bee data are available for this chemical. The only available honey bee toxicity data is acute contact adult honey bee data, which indicates aldicarb is highly toxic to bees on an acute contact basis. Below are Tier 1 honey bee toxicity data noted as data gaps in the registration review risk assessment:

- Non-guideline, OECD TG 213 (Tier 1): Honey bee adult acute oral toxicity
- Non-guideline, OECD TG 237 (Tier 1): Honey bee larvae acute toxicity
- Non-guideline, OECD TG 245 (Tier 1): Honey bee adult chronic oral toxicity
- Non-guideline, OECD Guidance Document 239 (Tier 1): Honey bee larvae chronic toxicity

In addition, the registration review risk assessment noted that higher tier toxicity tests (i.e., semi-field and/or field studies – Tier II and Tier III, respectively) may be needed, based on Tier I results.

Although there is a lack of honey bee toxicity data for aldicarb, Tier I toxicity data are available for other carbamate insecticides with similar structures. The following section describes EFED's Tier I risk assessment for the proposed new use of aldicarb on citrus in Florida.

Tier I Bee Screening Level Dietary Risk Assessment

Although aldicarb has only granule applications which limits contact with bees, it is a systemic pesticide that is anticipated to be available to honey bees through consumption of citrus pollen and nectar. Orange and grapefruit trees produce highly attractive pollen and nectar for honey bees (USDA 2017). Therefore, this assessment focuses on oral (dietary) exposure of bees to aldicarb.

As honey bee oral toxicity data are not available for aldicarb, EFED considered available toxicity data for similar chemicals as surrogates for aldicarb's toxicity. Aldicarb is an insecticide in the oxime carbamate chemical class. Structurally similar chemicals that are registered in the U.S. and have larger available datasets for honey bees include methomyl (PC Code 090301) and oxamyl (PC Code 103801). Chemicals in this class are acetylcholinesterase inhibitors whose mode of action works quickly on the target taxa (insects). Chemical structures for these compounds are included in **Appendix A**. **Table 1** shows the available honey bee Tier I toxicity data for these compounds. The acute contact toxicity data suggests the three chemicals have similar acute contact toxicity (within a factor of 5x), and for methomyl and oxamyl the other honey bee endpoints are all likewise within a factor of at most 7x, supporting a bridging approach among these similarly structured chemicals. Chronic endpoints for methomyl and oxamyl showed the most difference (7x), but they showed very similar effects on mortality and food consumption at the LOAEL dose. No chronic larval data is available for any of these compounds. EFED used the available NOAEL from the larval acute (7-d) study as a reasonable surrogate endpoint for evaluating potential chronic risk to bee larvae as this dose represents a level where there were no significant adverse effects observed.

Table 1. Tier 1 Honey Bee Toxicity Endpoints for Aldicarb, Methomyl, and Oxamyl

Study Type	Endpoint (µg a.i./bee)	Value for Chemical			MRIDs
		Aldicarb	Methomyl	Oxamyl	
Adult acute contact	LD50	0.29	0.068	0.31	00036935, E67983, 05001991
Adult acute oral	LD50	NA	0.28	0.094	45093001, 05001991
Adult chronic oral	NOAEL	NA	0.011	0.07	49830501, 49520701
	LOAEL	NA	0.017 (18%↑ mortality, 15%↓ food consumption)	0.12 (18%↑mortality, 24%↓ food consumption)	
Larval acute oral	LD50	NA	3.5	0.93	49876101, 49520702
Larval chronic oral[1]	NOAEL	NA	0.12[1]	0.36[1]	49876101, 49520702

NA=Not Available

Bold endpoints are used for risk estimation/characterization

[1] Larval acute oral NOAEL used as an approximation of potential chronic toxicity

BeeREX (version 1.0) was used to calculate Risk Quotients (RQs) for the proposed new use of aldicarb. The most sensitive of the adult and larval oral toxicity endpoints for methomyl and carbaryl (Table 1) were used to calculate RQs. Based on aldicarb's fate characteristics (Log Kow of 1.06, Koc of 49.5; MRIDs 4822504 and 42498202) and proposed application rate of 4.95 lb a.i./A, the Bee-REX estimated concentration of aldicarb in pollen and nectar following granular application is 2.75 mg a.i./kg. This results in estimated doses of 0.80 µg a.i./adult bee and 0.34 µg/larva. RQs for the most conservative caste/bee tasks are presented in **Table 2** and full Bee-REX RQs and inputs and outputs are provided in **Appendix B**. Acute and chronic RQs for adults exceed the levels of concern (LOCs; 0.4 and 1.0, respectively). For larval bees, the chronic RQ exceeds the LOC (1.0). Given that the chronic RQs were determined using the NOAEL from the acute (7-D) studies, there is potential that an actual 22-D chronic larval NOAEL may be lower and that chronic RQs may subsequently be somewhat higher than indicated here. Chronic larval data with aldicarb would be helpful to resolve this uncertainty but would be unlikely to change risk conclusions. When considering other life stages of adult worker bees, RQs also exceed the acute and chronic LOCs (**Appendix B**). Therefore, the proposed new use of aldicarb on citrus poses a risk of mortality to individual adult and larval bees.

Table 1. Tier 1 (Default) Oral Risk Quotients for Adult Nectar Forager and Larval Worker Honey Bees from Bee-REX (ver. 1.0)

Use Pattern	Max. Single Appl. Rate	Bee Caste/Task	Estimated Concentration (mg a.i./kg)	Oral Dose (µg a.i./bee)	Acute Oral RQ[1]	Chronic Oral RQ[1,2]
Orange/ Grapefruit	4.95 lb a.i./A	Adult nectar forager	2.75	0.80	**8.6**	**76**
		Larval worker (5-d old)	2.75	0.34	0.37	**2.8**

[1] **Bolded** RQ values exceed the acute risk LOC of 0.4 or chronic LOC of 1.0.
[2] The chronic larval RQ is actually an exposure:toxicity ratio representing the estimated oral dose compared to the larval NOAEL of 0.12 µg/larva derived from the methomyl acute larval study (MRID 49876101).

This Tier I risk assessment utilized the most sensitive endpoints for similar carbamate compounds. Confirmatory Tier I laboratory data for aldicarb would be helpful to better characterize the potential risks posed by aldicarb use on orange and grapefruit in Florida. Further, considering the results of the Tier I risk assessment which resulted in potential risks to individual adult and larval honey bees, submission of Tier II data that includes empirical residues in orange and/or grapefruit pollen and nectar and/or colony-level effects studies would allow for further refinement of the risk assessment. EFED recommends that submission of protocols precede test initiation for any Tier II data.

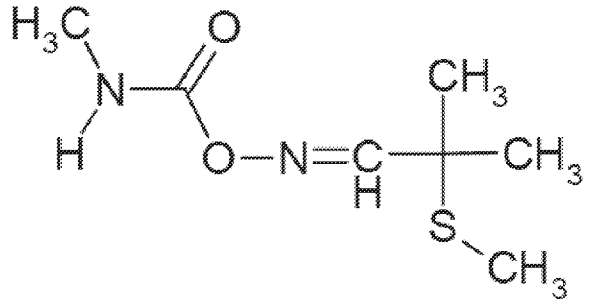
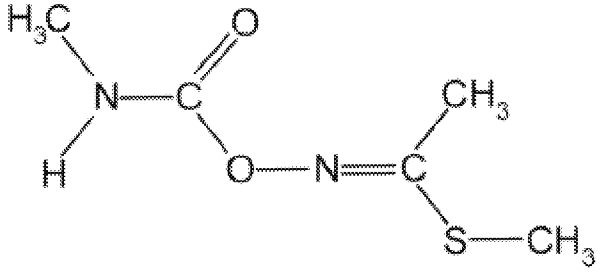
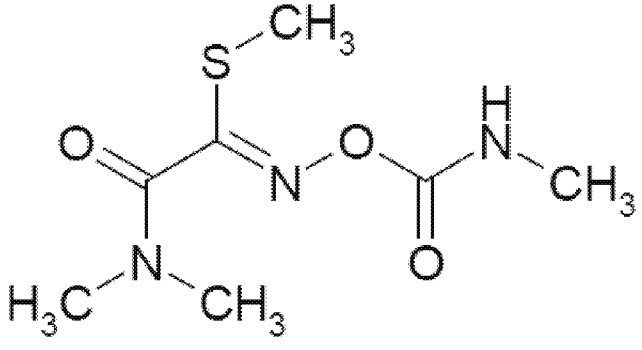
References

USDA. 2017. Attractiveness of Agricultural Crops to Pollinating Bees for the Collection of Nectar and/or Pollen. United States Department of Agriculture.

USEPA. 2006. EFED Aldicarb Ecological Risk Assessment (RED). Environmental Fate and Effects Division, Office of Pesticide Programs, Office of Prevention, Pesticides, and Toxic Substances. Washington, D.C. September, 2006.

USEPA. 2015. Preliminary Ecological Risk Assessment for Registration Review of Aldicarb. Environmental Fate and Effects Division, Office of Pesticide Programs, Offices of Chemical Safety and Pollution Prevention. Washington, D.C. October 6, 2015. D424563.

Appendix A. Chemical Structures for Oxime Carbamate Insecticides

Chemical	Structure
Aldicarb	
Methomyl	
Oxamyl	

Appendix B. Bee-REX input and output

Table 1. User inputs (related to exposure)

Description	Value
Application rate	4.95
Units of app rate	lb a.i./A
Application method	soil application
Log Kow	1.06
Koc	49.5
Are empirical residue data available?	no

Table 5. Results (highest RQs). Chronic larval values indicates ratio of exposure to acute NOAEL

MRID	Exposure	Adults	Larvae
4822504	Acute contact	NA	NA
42498202	Acute dietary	8.55	0.37
	Chronic dietary	75.80	2.83

Table 2. Toxicity data

Description	Value (µg a.i./bee)	Chemical	MRID
Adult contact LD50	0.285	Aldicarb	00036935
Adult oral LD50	0.094	Oxamyl	05001991
Adult oral NOAEL	0.0106	Methomyl	49830501
Larval LD50	0.931	Oxamyl	49520702
Larval NOAEL (*derived from acute study*)	0.12	Methomyl	49876101

Table 3. Estimated concentrations in pollen and nectar

Application method	EECs (mg a.i./kg)	EECs (µg a.i./mg)
foliar spray	NA	NA
soil application	2.751305388	0.002751305
seed treatment	NA	NA
tree trunk	NA	NA

Table 4. Daily consumption of food, pesticide dose and resulting dietary RQs for all bees

Life stage	Caste or task in hive	Average age (in days)	Jelly (mg/day)	Nectar (mg/day)	Pollen (mg/day)	Total dose (µg a.i./bee)	Acute RQ	Chronic RQ
Larval	Worker	1	1.9	0	0	5.22748E-05	5.6149E-05	0.000436
		2	9.4	0	0	0.000258623	0.00027779	0.002155
		3	19	0	0	0.000522748	0.00056149	0.004356
		4	0	60	1.8	0.170030673	0.1826323	1.416922
		5	0	120	3.6	0.340061346	0.3652646	2.833845
	Drone	6+	0	130	3.6	0.3675744	0.39481676	3.06312
	Queen	1	1.9	0	0	5.22748E-05	5.6149E-05	0.000436
		2	9.4	0	0	0.000258623	0.00027779	0.002155
		3	23	0	0	0.0006328	0.0006797	0.005273
		4+	141	0	0	0.003879341	0.00416685	0.032328
Adult	Worker (cell cleaning and capping)	0-10	0	60	6.65	0.183374504	1.9507926	17.29948
	Worker (brood and queen tending, nurse bees)	6 to 17	0	140	9.6	0.411595286	4.37867326	38.82974
	Worker (comb building, cleaning and food handling)	11 to 18	0	60	1.7	0.169755542	1.80591003	16.01467
	Worker (foraging for pollen)	>18	0	43.5	0.041	0.119794588	1.27441051	11.30138
	Worker (foraging for nectar)	>18	0	292	0.041	0.803493977	8.54780826	75.80132
	Worker (maintenance of hive in winter)	0-90	0	29	2	0.085290467	0.90734539	8.04627
	Drone	>10	0	235	0.0002	0.646557316	6.87826932	60.99597
	Queen (laying 1500 eggs/day)	Entire lifestage	525	0	0	0.014444353	0.15366333	1.362675